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Diversity of Coleoptera in Ziban Palm Groves, Biskra, Algeria

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Abstract: Diversity of Coleoptera in Ziban Palm Groves, Biskra, Algeria. *Misc. Pap*. 201: 1-9.

The present study was carried out to highlight species of Coleoptera order in five different palm groves at Ziban Oasis using pitfall trap. A total of 572 individuals of Coleoptera were collected. Belonging to 40 morphospecies and 13 families, the most represented family were Carabidae (9 genera and species), Tenebrionidae and Coccinellidae (7 species), Cetonidae and Curculionidae (3 species); *Coccinella septempunctata* (35 specimens), *Psyllobara viaintiduopunctata* (17 specimens) and *Calosoma inquisitor* (17 specimens) were most represented species in Ziban oases in number of individuals. Shannon diversity indices were lowest (2.067 bits) at El Kantara and greatest at El Ghrous palm grove (3.234 bits). Equitability was close to 1, that translates a favorable environment for biodiversity in equilibrium. Jaccard "J" similarity index calculated, shows that the highest value recorded was between Ain Ben Noui and Sidi Okba palm grove 47%, and the lowest was between El Kantara and Ouled Djellel palm grove 7%.

Keywords: Coleoptera, diversity, abundance, Ziban oases, palm groves, Biskra, Algeria.

Introduction

Due to the presence of many associated crops that occupy up to three levels of vegetation, oases ecosystem are home of abundant biodiversity. Occupying different ecological habitats (LaSalle and Gauld, 1993; Shaw and Huddleston, 1991), insects represent 3/4 of animal with two million of species (Hoffman and Vaughan, 2003), Coleoptera order is a largest group of insect with more than 350 000 species distributed throughout the world (Hanson and Gauld, 2006; Quicke, 2014). They play important roles in ecosystem (Majer, 1987) and contribute to its stability (Wiggins, 1983; Finnamore, 1996).

Because habitat structure can influences diversity and abundance of species (Urban and Smith 1989, Halaj *et al.*, 2000, Burnett *et al.*, 2007), oasis ecosystems contains numerous insect orders adapted for dry conditions (Deghiche Diab et *al.*, 2015a, b). Importance of Coleoptera in Ziban oasis ecosystem remains poorly known, nothing, to our knowledge, has been published so far on this order in this ecosystem. The first and the oldest research carried out on the entomofauna in North Africa was Vallier (1946) that identify species belonging to Coleoptera order. Later, Saharaoui (1998, 2014) was interested to Coccinellidae family of Coleoptera order in different Algerian agro- ecosystems.

Due to the originality of oasis ecosystem, the ecological interest of an inventory and the importance of Coleoptera order are therefore considerable, this is why our study aims to highlight the biodiversity of this order under oasis ecosystem in arid zones.

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Material and methods

At the south east of Algeria, Biskra region (34°, 48' N and 5°, 44' E) characterized by dry climate with total precipitation 80.27 mm, medium temperature between 5.5 °C (January) and 41.4°C (August) (2016-2017), our study was performed at five choosing palm groves; Ain Ben Noui palm grove (El Hadjeb); palm grove at El Kantara; Sidi Okba palm grove; palm grove at Ouled Djellel and finally El Ghrouse palm grove (Fig. 1, Table 1).

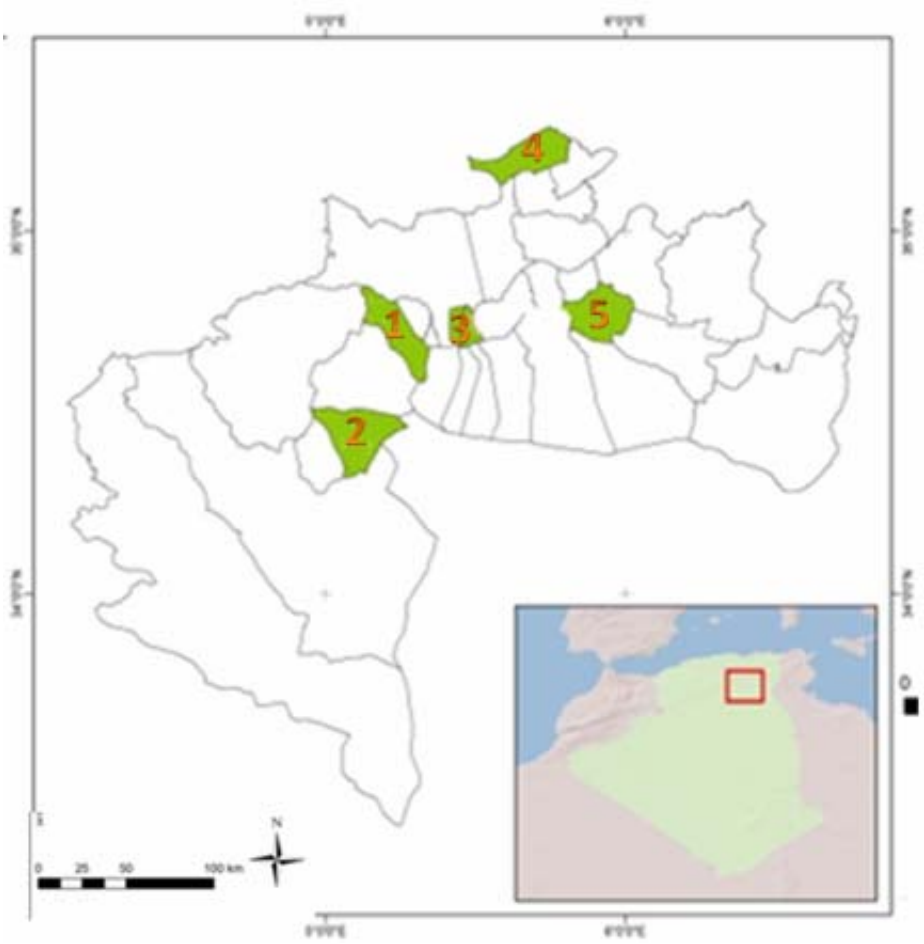

Fig. 1 - Palm groves location

Sampling methods

Inventories on field are based on the use of most adapted methods of collection (Lamottea and Bourlière, 1969; Godard, 2006). Coleoptera survey was performed weekly during a period of 11 months. In 1ha 6 pitfall traps were deposed on diagonal in each palm grove. Type of traps which we used were containers (a half plastic bottles) buried so that the rim of the collecting container is flush with the surface of the ground (Laub *et al.*, 2008).

In oasis, collected specimens were kept separately in plastic bottles. In laboratory, they were stored in 70° ethyl alcohol. Species were identified using reference collection and conformed by specialized person from Biskra University.

Table 1 - Characteristics of chosen Ziban palm groves.

	Localities	Geographical coordinates		Habitat specificities
Site (1)	80 km	34°36'43"N 5°05'22"E	468M ASL	youngest palm trees between the 5 chosen sites associated to grapevine and green houses. This area was also characterized by the variation of the wild flora surrounding oasis (Apiaceae, Brassicaceae, Caryophyllaceae, Asteraceae families).
Site (2)	100 km	34°25'16"N 5°04'34"E	194M ASL	greenhouses (tomato) and some annual crops (Cereals and faba bean). In addition we mention that this area (steppe zone) presents some specifics wild flora in and around oasis (Amaranthaceae, Tamaricaceae and Fabaceae families).
Site (3)	10 km	34°46'43"N 5°44'05" E	115M ASL	Oldest palm grove (80 years), cultivating fodder crops for feeding animal. Wild flora families were especially Asteraceae, Fabaceae, Poaceae, Cyperaceae and Amaranthaceae
Site (4)	20 km	34°45'43 N 5°53'05 E	90M ASL	4ha of date palm 10 years old associated to olive trees and greenhouse tomatos. Wild flora was especially from Fabaceae, Borraginaceae, Cucurbitaceae and Cyperaceae families.
Site (5)	30Km	34°43'25"N 5°22' 13"E	468M ASL	figs cultivation (Fig. 1) pomegranates in addition to the date palm (Deglet Nour) which are 35-40 years old. Wild flora was specially belonging to Asteraceae, Fabaceae, Amaranthaceae and Apiaceae families.

Statistical analysis using PAST-Version 2.17 program

Parameter used for analyzing Coleoptera order under palm grove ecosystem were; total wealth (S), relative abundance, Shannon index ($H'=\log 2-\Sigma pi$), evenness ($E=H'/H'_{max}=H'/\log 2S$) and Jaccard's index ($C j)=j/(a+b-j)$ using Paleontological Statistics; PAST-Version 2.17 software .

Results and discussion

From the five palm groves distributed all over Ziban oases and are view of 44 samples collected during the study period of 11 months, the analysis of the global faunal composition led to the determination of a collection of 521 individuals belonging to 40 species unequally represented between 13 families, 39 genera (Table 2).

Table2 - Collected coleopteran species under palm grove ecosystem

Families	Genera	Species
Cetoniidae	*Tropinota*	*Tropinota (Epicometis) hirta* (Poda, 1761)
		Tropinota squalid (Scopoli, 1783)
	Hoplia	*Hoplia argentea* Poda, 1761
	Protaetia	*Protaetia morio* (Fabricius, 1781)
Coccinellidae	*Psyllobara*	*Psyllobara viaintiduopunctata* (Linnaeus, 1758)
	Coccinella	*Coccinella septempunctata* (Linnaeus, 1758)
	Pharoscymus	*Pharoscymus ovoideus* (Sicard, 1929)
	Cybocephalus	*Cybocephalus palmarum* (Peyerimhoff, 1931)
	Pharoscymnus	*Pharoscymnus numidicus* (Pic, 1900)
	Stethorus	*Stethorus punctillum* (Weise, 1891)
	Chilocorus	*Chilocorus bipustulatus* (Linnaeus, 1758)
Buprestidae	*Agrilus*	*Agrilus scythicus* (Królik et Janicki, 2005)
	Anthaxia	*Anthaxia nitidula* (Linnaeus, 1758)
Tenebrionidae	*Pimelia*	*Pimeliapayraudi* (Latreille, 1829)
	Diaperis	*Diaperis maculata* (Olivier, 1791)
	Gonocephalum	*Gonocephalum granulatum nigrum* (Küster, 1849)
	Blaps	*Blaps sp*
	Erodius	*Erodius emondi* (Solier, 1834)
	Akis	*Akis lusitanica* (Solier, 1836)
Apionidae	*Aspidapion*	*Aspidapion aeneum* (Fabricius 1775)
Aphodiidae	*Ophodius*	*Ophodius sp*
Carabidae	*Calosoma*	*Calosoma inquisitor* (Linnaeus, 1758)
	Sphodrus	*Sphodrus leucophtalmus* (Linnaeus, 1758)
	Broscus	*Broscus* sp
	Brachinus	*Brachinus explodens* (Duftschmid, 1812)
	Lophyra	*Lophyra flexuosa* (Fabricius, 1787)
	Anthia	*Anthia sexmaculata* (Fabricius, 1787)
	Harpalus	*Harpalus rufipes* (De Geer, 1774)
	Bembidion	*Bembidion sp*
	Cicindela	*Cicindela campestris* (Linnaeus, 1758)
Dasytidae	*Psilothrix*	*Psilothrix viridicoerulea (Geoffroy, 1785)*
Scarabaeidae	*Scarabaeus*	*Scarabaeus sacer*. (Linnaeus, 1758)
	Amphimallon	*Amphimallon solsticialis* (Linné, 1758)
Curculionidae	*Larinus*	*Larinus flavescens* (Germar, 1824)
	Liophloeus	*Liophloeus tessulatus* (Müller, 1776)
	Cleonis	*Cleonis pigra* (Scopoli, 1763)
Meloidae	*Mylabris*	*Mylabris bipunctata* (Linnaeus,1767)
Buprestidae	*Anthaxia*	*Anthaxia nitidula* (Linnaeus, 1758)
	Agrilus	*Agrilus sp*
Brachyceridae	*Brachycerus*	*Brachycerus undatus* (Fabricius, 1798)
13	**39**	**40**

The most representative were the Carabidae family with 9 genus and species, followed by Tenebrionoidae and Coccinellidae family with 7 species for each, in the 3rd position Cetonidae family and Curculionidae family with 3 species for each. The Buprestidae, Apionidae, Brachyceridae, Buprestidae, Meloidae, Scarabaeidae, Dasytidae and Aphodiidae were represented only by one to two species for each (Table.2).

The dominance of Carabidae family can be related to their large representation in the world with more than 40 000 species (Larochelle, 1990). The type of traps applied and their design can explain presence of this family (Spence and Niemela, 1994), in which they were easily sampled (Melbourne, 1999).

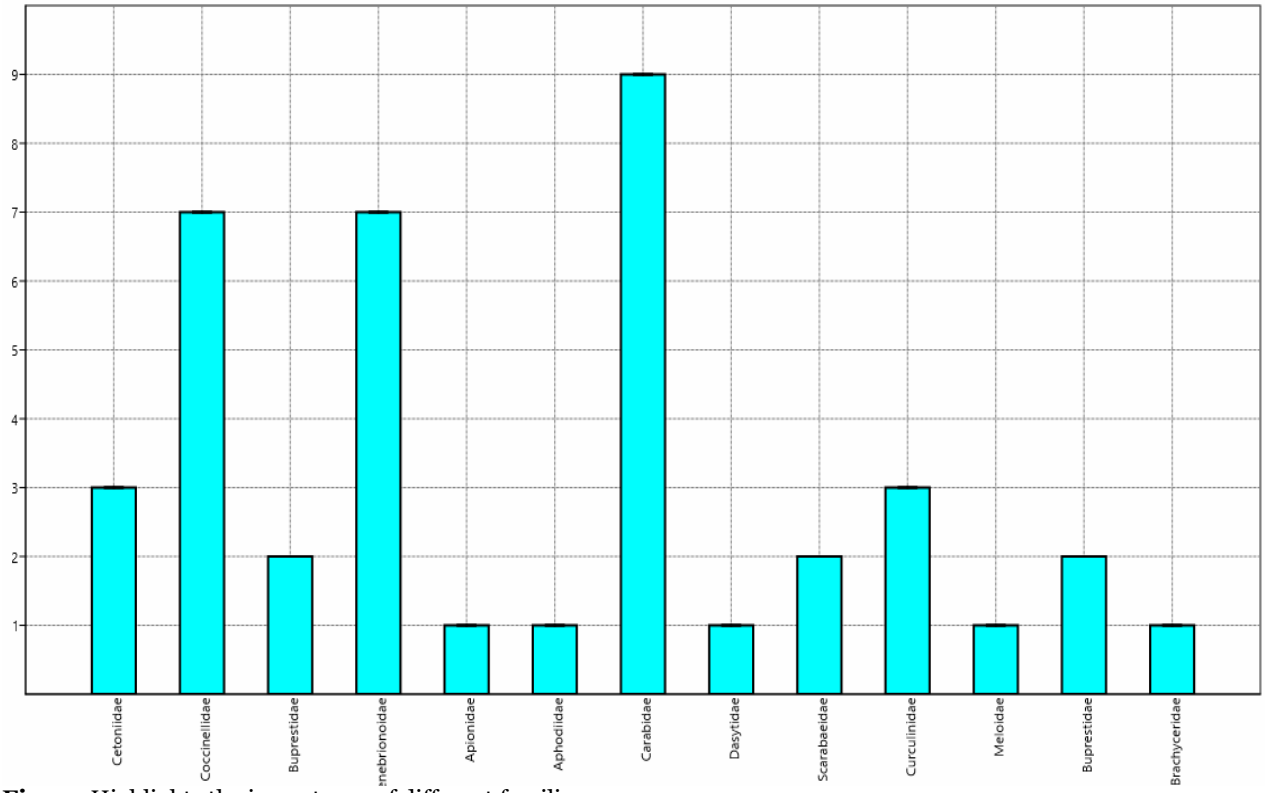

Fig. 2 - Highlights the importance of different families.

To illustrate the variations of this faunistic composition, we have also represented it in number of species and number of individuals. Population of Carabidae family in Ziban oases was dominated by essentially *Calosoma inquisitor* (17 specimens) and *Brachinus explodens* (14 specimens). The family of Tenebrionidae was represented by *Blaps* sp (16 specimens), *Pimelia payraudi* (13 specimens) and *Erodius emondi* (12 specimens) (Table 2).

Coccinellidae family was represented by specimens of *Coccinella septempunctata (35 specimens*) and *Psyllobara viaintiduopunctata* (17 specimens). The importance of this family was also confirmed by Sahraoui *et al.* (2014), were they reported a richness of 48 taxa and 22 genera inventoried specially from arid and Saharan ecosystem.

The large representation of *Calosoma inquisitor* (Linneaus, 1758), in our pitfall traps was probably related to the favorable climatic conditions (Dajoz 1985) of oases ecosystem, as well as the availability of prey on host plants where they overwintering (Bertolaccini *et al.*, 2011, Couturier, 1973).

The important presence of Coleoptera order in different palm grove was also indicated by numerous authors; Ben Ameur-Saggou (2009) in Ouargla region where she reported 22 species. Moreover, in Biskra region, Achoura (2010) recorded 8 species. In the same region, monitoring using different type of traps in five palm groves by Deghiche-Diab, (2015a) and Deghiche-Diab,(2015b), reported 23 and 42 species respectively.

Shannon Diversity Indices, calculated for each area or trapping palm grove provide insight into the distribution of species according to the type of biotope. The diversity in El Kantara palm grove was the lowest (2.067 bits) and greatest at El Ghrous palm grove (3.234 bits).The values recorded show the co-dominance of several species. This high value indicates that the species of Coleoptera caught in the Ziban were diversified and considered homogeneous from one palm grove to another, where the climate is tolerable and food resources seem available.

Table 3 - Evenness index E, Diversity index H′, Margalef index and Jaccad index in palm grove

Palm groves	Species richness	Evenness index, E	Diversity index, H′
Ain Ben Noui	27	0.8117	3.087
OuledDjellel	19	0.7863	2.704
El Ghrous	35	0.8782	3.425
El Kantara	9	0.8782	2.067
Sidi Okba	29	0.8753	3.234

For Evenness (E), it is close to 1, so our observed diversity is close to maximum diversity in all palm groves. It translates that environment is favorable for biodiversity and the numbers of different species caught are in equilibrium with each other (Table 3).

With two million of insect species (Hoffman and Vaughan, 2003), Coleoptera was the most represented order in the world characterized by a diversified way of life (phytophagous, predators, decomposers, etc.) (Leraut, 2003), that play an ecological role in oases ecosystems.

From 40 species of Coleoptera order inventoried in Ziban palm groves, three major groups (Fig. 3) were noted. The most important group was zoophagous with 24 species. This indicates that more than half of the species were predators and can maintain pest crops under control in oasis system. In the second position phytophagous group with 12 species, whereas polyphagous group was represented only by 4 species.

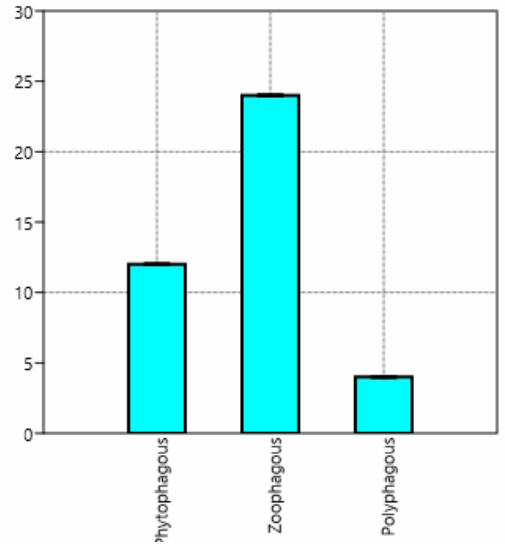

Fig. 3 - Ecological groups of coleopteran species in Ziban palm groves

Species belonging to Coccinellidae family are major predatory considered beneficial since they feed on insect pests, both larval and adult and constitute good predators well known for their effectiveness against aphids, there were also predatory species of scale insects and many other (white flies, mites ...) auxiliary crops (Burgio *et al.*, 2006; Ricard *et al.*, 2011) and occurs in different type of habitats; under tree bark, in oases litter, on plant foliage, flowers and fruits, as well as in caves. A type of lady bird (*Stethorus punctillum*) was also recorded in our pitfall traps used as a predator against mite (*Olygonichus afrasiaticus)* in an IPM programme in oases ecosystems (Deghiche-Diab and Belhamra, 2015c , Idder and Pintureau, 2008).

Another most represented species in our pitfall traps during all seasonal survey period was *Pimelia payraudi* a saprophagous flightless species (Hermans *et al.*, 2003)

Presence of the weeds favored by addition of the organic matter in oases ecosystem increase population of certain species like *Harpalus rufipes* (De Geer, 1774) belonging to the omnivorous

groups that have beneficial potential for agriculture relies on its great voracity of weeds seeds species (Luff, 1980). Belonging to the same group, *Scarabaeus sacer* (Linnaeus, 1758) species was reported in oases characterized by the presence of livestock in the favors the maintenance of a particular fauna subservient to dung.

Our results are relatively important compared to inventories in oases ecosystem, where Deghiche-Diab (2015c), reported a high percentage of zoophagous species (36.52%) from wich coleopteran order was indicated at five sampling palm grove, Achoura and Belhamra (2010), reported 20,83% of zoophagous species in El Kantara palm groves.

To identify the similarity between samples of Coleoptera species communities collected from the different palm groves, the Jaccard index was used for binary data. This index varies from 0 to 1 that takes into account only positive associations (Youness *et* Saporta, 2004).

Table 4- Similarities of studied coleopteran communities (Simpson and Jaccard coefficients)

Jaccard coefficient of similarity.

	A	O	G	E	S
A		0,28	0,44	0,20	0,47
O	0,53		0,32	0,08	0,26
G	0,70	0,68		0,26	0,45
E	0,67	0,22	1,00		0,19
S	0,67	0,53	0,69	0,67	

Simpson coefficient of similarity

Matrix obtained for Jaccard "J" similarity index calculated (Table 4), shows that the highest value recorded was 47% between Ain Ben Noui and Sidi Okba palm grove with, 45% between El Ghrous and Sidi Okba palm grove. In contrast, the lowest similarity value was 7% between El Kantara and Ouled Djellel palm grove, 18% between Sidi Okba and El Kantara palm grove.

Those results indicate that there were few common species between visited palm groves and there were a number of heterogynous specific species in each palm grove.

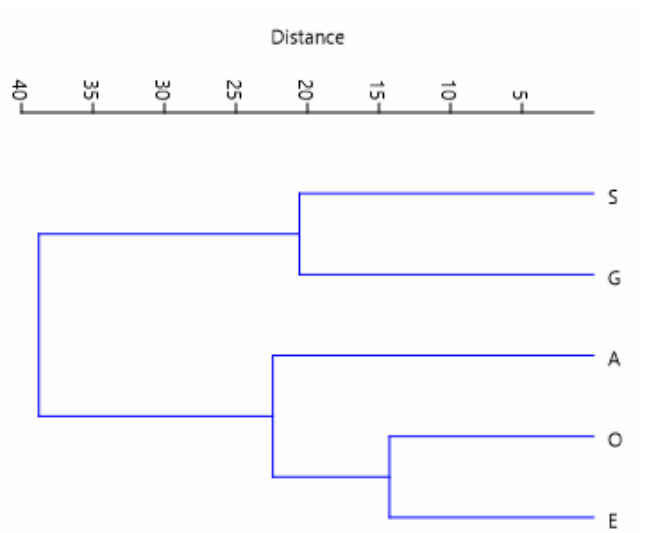

Fig. 4 - Cluster analysis of similarity of coleopteran in different sites (Ward's method).

We also compared Coleoptera species composition in different palm groves using cluster analysis. Obtained dendrogram (Fig.4) were two well-supported clusters indicating lower similarity of species compositions in palm grove.

Conclusion

However, inventory of Coleoptera species in palm groves is far to be completed, it is imperative to continue this work to expand research for purpose of safeguarding biodiversity in arid zones especially oases ecosystem with the establishment of an actualized list and species to be protected.

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[2] http://www.cesa-tr.org/Pri.htm
[3] http://www.cesa-tr.org/Miscell.htm
[4] http://www.cesa-tr.org/Memoirs.htm
[5] http://www.cesa-tr.org/CDF.htm
[6] http://www.cesa-tr.org/Icon.htm
[7] http://www.cesa-tr.org/CPAL.htm
[8] http://www.cesa-tr.org/Cesanews.htm
[9] http://www.cesa-tr.org/Cesabooks.htm